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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
A24C 5/18, B29C 35/10, D21F 1/00 — **A1**

(11) International Publication Number: **WO 97/30604**

(43) International Publication Date: 28 August 1997 (28.08.97)

(21) International Application Number: PCT/GB97/00454

(22) International Filing Date: 19 February 1997 (19.02.97)

(30) Priority Data:
9603575.3 20 February 1996 (20.02.96) GB

(71) Applicant *(for all designated States except US)*: SCAPA GROUP PLC [GB/GB]; Oakfield House, 93 Preston New Road, Blackburn, Lancashire BB2 6AY (GB).

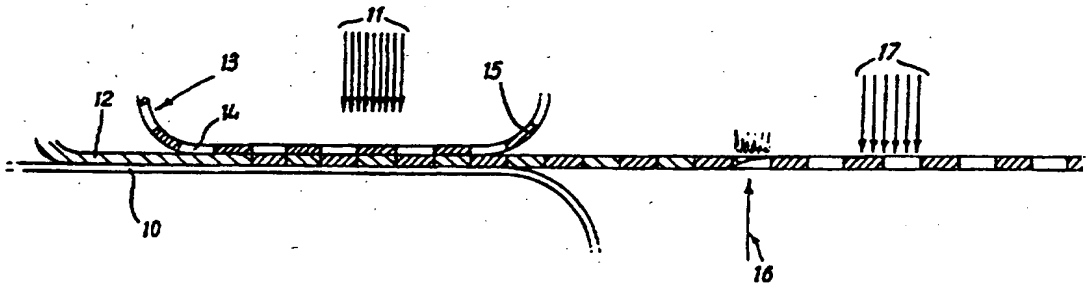
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: SAYERS, Ian, Christison [GB/GB]; 30 Chesterbrook, Ribchester, Lancashire PR3 3XT (GB).

(74) Agents: GOODWIN, Mark et al.; Wilson Gunn M'Caw, 41-51 Royal Exchange, Cross Street, Manchester M2 7BD (GB).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: TOBACCO CONVEYOR BELT



(57) Abstract

A method of producing a tobacco conveyor belt comprises the steps of providing a layer of light curable polymeric resin material in fluid form on a support (10), illuminating the layer of material through a mask (13) selectively transparent to the illumination so as to effect at least partial curing of the material of the sheet in positions corresponding with the transparent regions of the mask, removing uncured polymeric material and effecting a full cure of the residual material.

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TOBACCO CONVEYOR BELT

The present invention relates to tobacco conveyor belts for use in the manufacture of cigarettes and preferably, but not exclusively to so-called suction tapes.

During the manufacture of cigarettes a measured quantity of tobacco is taken up from a first tobacco conveyor belt by a second tobacco conveyor belt, i.e. the so-called suction tape, suction tapes generally having a width in the range from 0.5 to 1.5cm. A diagrammatic illustration of a machine for making cigarettes is shown in Fig.1. Each disposed line of tobacco is urged from the first tobacco conveyor belt 1 against the underside of a suction tape 2. The suction tape 2 runs within a groove in a suction box 3, the base of the groove being defined by a recessed ladder-like structure defined by two or more longitudinal rods linked together at spaced intervals by bars. The suction box 3 ensures that the suction tape 2 is urged upwardly against the recess ladder-like structure so that the tobacco is urged against the underside of the suction tape 2. The tobacco rod thus formed is removed from the suction tape 2 by means of inclined scraper blades 5, whereupon it falls onto enveloping cigarette paper supplied on a further conveyor belt, i.e. the so-called garniture belt 4.

Various grades of tobacco are processed using the tobacco conveyor apparatus. Ideally different grades of tobacco are processed using tapes having differently sized interstices.

Conventional suction tapes are woven endless, or alternativ ly are flat woven and then joined by ultrasonic

means. Such tapes are expensive to produce.

The present invention seeks to provide a relatively cheap method of making a number of tobacco conveyor belts having a range of size of interstices therethrough.

According to a first aspect of the present invention there is proposed a method of producing a tobacco conveyor belt which comprises the steps of providing a layer of light curable polymeric resin material in fluid form on a support means, illuminating said layer of material through a mask selectively transparent to the illumination so as to effect at least partial curing of the material of the sheet in positions corresponding with the transparent regions of the mask, removing uncured polymeric material and effecting any necessary full cure of the residual such material.

According to a second aspect of the present invention there is provided the use of an apparatus in making a tobacco conveyor belt, said apparatus comprising feed means for delivering fluid polymeric material, a support means to receive said material from the feed means, a source of illumination positioned to illuminate polymeric material present on the support means, the source of illumination being adapted to direct sensibly parallel light towards the support means, and a transparent mask intermediate the source of illumination and the support means and through which light moves to polymeric material positioned thereon, the mask being selectively transparent in accordance with opaque patterning applied thereto.

According to a pref rred f ature, the support means is

defined by a continuously moving band and the mask comprises an endless loop having a run arranged in spaced parallel disposition relative to the support surface and advanced at a like rate to the movement of the band.

According to a further preferred feature, the feed means comprises a curtain coater delivering a continuous sheet of fluid polymeric material to the support surface.

The belts of the invention may solely consist of photopolymeric material optionally reinforced with fibre/yarn material, usually at the tobacco support surface. However, the said polymeric resin material may be provided on a base structure that may be woven or nonwoven. The nonwoven base structure may comprise a felt, a knitted structure or a moulded mesh structure, optionally having reinforcing yarns extending preferably within the lands of the mesh and extending in the machine direction of the belt.

Examples of suitable photopolymer materials included the following UV-curable resins:-

i) epoxy acrylates, eg. Actilane 320 (trade mark);

ii) polyester acrylates, eg. Actilane 505 or Setacure 579 (trade mark);

iii) silicone acrylates, eg. Actilane 800 (trade mark); or

iv) acrylic acrylate, eg. Setacure 572 (trade mark).

The UV-curable resin may additionally contain one or more reactive diluents, eg. dipropylene glycol diacrylate eg. Actilane 422 (trade mark), tripropylene glycol diacrylate eg. Actilane 424 (trade mark), trimethylol propane ethoxylate triacrylate eg. Actilane 430 (trade mark), glycerol

propoxylate triacrylate eg. Actilane 432 (trade mark), or mono-, di-, tri- or tetra-functional aliphatic acrylates eg. Actilane 421 (trade mark). These reactive diluents improv properties such as adhesion of the resin to the substrate and flexibility of the cured coating.

All of the above trade marks are trade marks of Akcros Chemicals.

It is noted that suction tapes do not run completely within a slot, but instead bridge it so that the edge sections of the tape are in contact with metal runners. Control of the edge sections with these runners result in wear in the edge regions. The present invention seeks to solve this problem by making the edge regions of the tape thicker in the width direction so as to provide greater edge strength, for resistance to cutting and wear by possibly corroded and/or sharp edges of the metal runners. The use of more material in the edge runners further improves abrasion resistance and results in a significant reduction in the amount of tobacco held in the edge recesses. It is noted that the use of conventional woven tapes result in a large build up of tobacco in the weave interstices of the tape at the edge regions.

The required structure may be achieved by using a pinned plate whose interstices at the edges have a greater width and/or depth (say 15-100% greater dimensions) so that when molten polymer is cast onto the plate there is a higher proportion of polymer matrix in the edge regions. Where the molten polymer is provided by means of a core - sheath yarn with a meltable sheath material it is preferred that the core

yarns have a larger diameter than those in the centre of the tape, and/or the diameter of the yarn itself may be gr ater due to a larger sheath. If only reinforcing yarns are laid on a case molten polymer then these too are preferably of greater diameter at the edges than those in the centre regions for the same reason, namely that there is a larger volume of polymer matrix to reinforce.

The edge of the belt may not have a uniform width, whereby at least some of the cross-machine lands extend beyond the main body of the fabric in the width direction by a distance of 0.2 - 0.8mm so as to improve the guiding of the belt and extend the life of the belt by allowing more wear before failure.

The centre running land may be coloured by coating or by incorporating pigment or dye into the polymer matrix material of the running direction land. The resultant, preferably red, coloured line can be used to assist the calibration of a cigarette machine by means of an infra-red sensor each time a belt is replaced.

At least one ultra-violet sensitive material, such as an optical brightener may be added to a constituent matrix polymer of the belt, so that once the tobacco conveyor belt is subjected to a certain degree of wear, said UV-sensitive material is immediately detected by sensors located immediately downstream of the belt apparatus, indicating that the belt is ready for replacement. Fabric wear can be detected at an early stage, preventing the accumulation of polymer material in the tobacco, which should otherwise be

harmful if combusted.

The smoothness of the faces of the tobacco conveyor belt can be selected so as to suit the end use of the belt. Generally suction tapes for medium speed cigarette making machines handling long fibre tobacco are relatively smooth on both the suction box face and the tobacco contacting face of the tape. However, the tapes for use with normal tobacco blends have a relatively high coefficient of friction on both faces of the tape. With high speed machines handling expanded tobacco blends the suction box side of the belt is relatively smooth and the tobacco contacting side is relatively rough having a higher coefficient of friction in order for a sufficient quantity of tobacco to be picked up by the belt. This high coefficient of friction may be achieved either by providing the tobacco contacting surface of the belt with a regular or random pattern of profiles, especially regularly spaced ribs in the transverse direction and/or by means of a wear resistant material such as silica, alumina, ceramic, Cabosil (trade mark), carborundum, metal or hard polymer particles to induce high friction. With moulded base structures said wear resistant particles are added into the pin plate prior to the matrix polymer melt and become embedded in the surface region of the polymer material. The friction coefficient lowering material, typically an ormocer, ultra high molecular weight (UHMW) material (eg. polyethylene or polypropylene) may be provided on the suction box slot side of th belt to reduce the heat generated as a result of the friction forces betw en the belt and the box as said belt

travels at a speed in the order of 400-800 m/s at a vacuum of 50-150 mbar.

The invention will now be described further, by way of example only, with reference to the accompanying drawings in which:-

Fig.1 is a diagrammatic illustration of a conventional cigarette making machine;

Fig.2 is a diagrammatic illustration of the successive steps in the method of the invention;

Fig.3 is a diagrammatic view of apparatus for use in practising the invention;

Fig.4 shows one embodiment of a tobacco conveyor belt made in accordance with the invention;

Fig.5 shows a second embodiment of a tobacco conveyor belt made in accordance with the invention; and

Fig.6 shows a third embodiment of a tobacco conveyor belt made in accordance with the invention.

The machine of Fig.1 has been discussed in detail in the introductory paragraphs hereof and will not be discussed further here.

Referring now to Fig.2 of the drawings, a photopolymeric resin material is applied to the surface of a moving conveyor belt 10, the viscosity of the resin being such as to form a layer 12 of uniform thickness thereon, and a selectively transparent mask 13 is brought into closely spaced relationship with respect to the upper surface of layer 12 for advancing movement therewith. The band 12 includes transparent and opaque regions 14, 15 respectively.

The layer 12 of resin material is subjected to illumination as at 11, through the mask 13, of a kind such as will effect at least a partial cure of that material in locations thereof in register with the transparent regions 14 of the mask, the illumination being in a direction normal to the surface of the mask.

After illumination, the mask is moved away from the surface of the layer of photopolymeric material, and such material advances to be subjected to a localised jet of pressure air, as at 16, whereby uncured polymer is removed, thus creating apertures in the partially cured layer in positions corresponding to the opaque regions of the mask.

The apertured resin sheet is then subjected to further illumination so as fully to cure the resin, as at 17.

Apparatus suitable for practising the method is shown diagrammatically in Fig.3 and will be seen to comprise a curtain coater 21 which supplies a layer 23 of a light-curable material of uniform thickness to the support surface 22 of an endless band 24, the support surface 22 having an easy release characteristic relative to the light-curable material and is typically of polytetrafluoroethylene.

An endless mask 26 is positioned above the band 24, a lower run 27 of the mask being spaced from the support surface 22 by an amount sufficient to accommodate the material layer 23 present on the support surface 22 and to provide a small clearance between such material layer and the mask. The mask 26 is driven at a like linear speed to that of the endless band 24, and the "laminate" of the lower run 27 of the

mask 26, the material layer 23 and the support surface 22 of the endless band 24 move together.

Mask 26 is selectively transparent, in the sense that regions are provided thereon which are opaque to the radiation necessary to effect curing of the light-curable material, the regions, in the case under consideration, being circles of small diameter provided at close centres.

An elongated ultra violet light source 31 is provided within the loop of endless mask 26, the light source 31 further including a parabolic reflector 32 so positioned as to deliver parallel ultra violet light to the mask in a direction perpendicular thereto.

The apparatus further includes pressure fluid means 33, preferably a compressed air jet, at a position downstream both of the mask 26 and the band 24, there being extractor means 34 arranged in register with the pressure fluid means 33 and at the opposite side of the layer 23 with respect thereto.

An additional curing means 35 is included downstream of the pressure fluid means 33, the radiation supplied by said curing means being of a kind appropriate to effect curing of the photopolymeric material.

The apparatus is completed by a take-up roll 36 to receive fully cured apertured material.

In one particular example the photopolymeric material used consisted of a halogen-free and nitrogen-free photopolymeric material such as an epoxy acrylate or most preferably a polyester acrylate. The acrylate moieties are the active centr s in so far as curing is concerned and the

initiator is based on acetophenone. A 1 mm thick layer of the photopolymeric material was laid on the support surface and the mask was so positioned that the lower run thereof was spaced from the surface of such material by a distance of 12nm. The light source, which source was positioned 1 metre above the photopolymeric material, was such as to provide radiation of a dominant wavelength (Lambda max.) of 365 nm to give a partial cure time of 30 secs. The apertures in the mask were circular in form, each being 1 mm in diameter and being provided at 2 mm centres.

It is to be appreciated that the thickness of the material layer and the geometry of the individual apertures and their disposition, will be selected according to particular requirements, and that the cure time will vary appreciably according to the intensity of the illumination and the spacing of the light source from the photopolymeric material.

Furthermore, it is to be understood that the wavelengths of the ultra violet light emitted by the source will extend over a range of between 250 and 400 nm, although the initiator reacts to wavelengths within a narrow band of, say, 360-370 nm. The light source will, of course, be selected having regard to the wave-lengths required to effect reaction of the initiator included in the photopolymeric materia. It is to be appreciated that the method and apparatus as aforesaid will allow of the production, as a continuous process, of apertured sheet material in a simpl and economic manner. The thickness of the sheet may be varied to suit particular requirements,

whilst the particular formulation for the photopolymeric material will be selected having regard to the characteristics required in the end product.

If it is required to improve the tensile strength of the sheet material, yarns and/or fibres may be included in the mix applied to the support surface 22 of the endless band 24. Alternatively or additionally yarns and/or fibres may be embedded in the body of the belt and/or may protrude on the tobacco contacting face and/or non tobacco contacting face.

The facility for selective curing of the material applied to the support surface 22 of the endless band 24 which arises from the use of a mask provides for the production of apertured structures of a broad range of permeabilities and this merely by suitable selection of aperture size and spacing. As will be recognised the method of the invention does make possible the creation of a graded permeability towards the edges of the sheet merely by use of a mask of an appropriate form.

The form of reflector is intended to ensure that the light reaching the mask is parallel light, thereby to ensure accuracy in aperture form and size, although it is thought that, by judicious selection of the light source and reflector, apertures having cross-sectional dimensions which vary progressively, in the thickness direction of the material may be possible.

Whilst the invention is described in the context of irradiation by ultra violet light, it is to be recognised that other energy sources may be utilised, and in this regard

mention is made of such as an electron beam as a source of irradiation.

The apertured structure as aforesaid, is ideal for use as a tobacco conveyor belt. By using different masks having differently proportioned transparent regions a number of belts may be produced by this method, the belts having differently sized interstices in order to suit various grades of tobacco being processed using the belt.

Referring to Fig.4 there is illustrated a tobacco conveyor belt 40 made in accordance with the above referenced method. This belt 40 has a number of perforations therethrough. The belt 40 may optionally be reinforced with fibre/yarn material of the tobacco support surface.

Fig.5 shows a second tobacco conveyor belt 41 which comprises a nonwoven felt base structure 42 onto which a structure 43 of the type illustrated in Fig.4 is located in accordance with the method previously described.

Fig.6 shows a further twin layered tobacco conveyor belt 44 similar to that described in Fig.5 except in that a different base structure 45 is used. The base structure 45 has a regular, nonwoven mesh structure.

The conveyor belt has particular, but not exclusive use, as a suction tape. The belts of the invention may be made endless so as to avoid the need for complicated joining methods, for example by ultrasonic welding. Suitable methods for making endless structures are described hereinafter. The absenc of a joint eradicates a major weak point in the structure. The tensil strength may be enhanced by the

incorporation of longitudinally extending reinforcing yarns, ideally of high modulus, low elongation material wholly in the lands of the mesh running in the intended machine direction of the belt. A woven fabric possesses a high degree of crimp. Hence a large number of positions of localised wear are present in known woven structures. However, in the mesh structure of the present invention the reinforcing yarns are embedded within a polymer matrix as described above. Therefore there can be no localised wear of the reinforcing yarns. Examples of suitable materials for the reinforcing yarns include aramid, liquid crystal polymer and Nomex (trade mark). The matrix material is generally a thermoplastic polymer which preferably does not form any toxic substances if pyrolysed as a consequence of abraded polymer particles entering into the tobacco and then being subjected to thermal degradation as the cigarette is smoked. Preferred matrix materials include polyamide, polyester, polyolefins (eg polyethylene or polypropylene), silicones and oxide polymers (eg polyphenylene oxide).

No expensive and complicated weaving or knitting machinery is required for manufacture.

The mesh belt is completely nonwoven and is formed by casting a molten polymer onto a pinned plate, such that the melt fills the interstices between the pins to form a regular mesh structure. The belts of the invention may be made endless by spirally melting a yarn onto an optionally rotatable, pinned drum. Alternatively the two ends of a flat moulded structure are brought into butting or overlap

relationship on a pinned plate. The two ends of the belt are then softened and fused together.

CLAIMS

1. A method of producing a tobacco conveyor belt which comprises the steps of providing a layer of light curable polymeric resin material in fluid form on a support means, illuminating said layer of material through a mask selectively transparent to the illumination so as to effect at least partial curing of the material of the sheet in positions corresponding with the transparent regions of the mask, removing uncured polymeric material and effecting any necessary full cure of the residual such material.

2. A method of producing a tobacco conveyor belt as claimed in claim 1, wherein the support means is defined by a continuously moving band.

3. A method of producing a tobacco conveyor belt as claimed in claim 1 or claim 2, wherein the mask comprises an endless loop having a run arranged in spaced parallel disposition relative to the support means and is advanced at a like rate to the movement of the support means.

4. A method of producing a tobacco conveyor belt as claimed in any preceding claim, wherein a curtain coater delivers a continuous sheet of fluid polymeric material to the support surface.

5. A method of producing a tobacco conveyor belt as claimed in any preceding claim, wherein the belt consists of said light curable polymeric material reinforced with fibre/yarn.

6. A method of producing a tobacco conveyor belt as claimed in any pr ceding claim, wherein the belt consists of light curable polymeric material provided on a base structure.

7. A method of producing a tobacco conveyor belt as claimed in claim 6, wherein the base structure is woven.

8. A method of producing a tobacco conveyor belt as claimed in claim 6, wherein the base structure is nonwoven.

9. A method of producing a tobacco conveyor belt as claimed in claim 8, wherein the base structure comprises a felt, a knitted structure or a moulded mesh structure, optionally having reinforcing yarns extending within the lands of the mesh and extending on the machine direction of the belt.

10. A method of producing a tobacco conveyor belt as claimed in any preceding claim, wherein the light curable polymeric material comprises any of the following: epoxy acrylates, polyester acrylates, silicone acrylates or acrylic acrylate.

11. A method as claimed in any preceding claim, wherein the light curable polymeric material comprises at least one UV sensitive material which is operable to be detected by sensors when the belt is subjected to a certain degree of wear.

12. A method as claimed in any preceding claim, wherein a tobacco contacting surface of the belt is provided with a regular or random pattern of profiles.

13. A method as claimed in claim 12, wherein the profiles are provided by spaced ribs.

14. The use of an apparatus in making a tobacco conveyor belt, said apparatus comprising feed means for delivering fluid polymeric material, a support means to receive said material from the feed means, a source of illumination position d to illuminate polymeric material pres nt on the support means, th sourc of illumination being adapted to

direct sensibly parallel light towards the support means, and a transparent mask intermediate the source of illumination and the support means and through which light moves to polymeric material positioned thereon, the mask being selectively transparent in accordance with opaque patterning applied thereto.

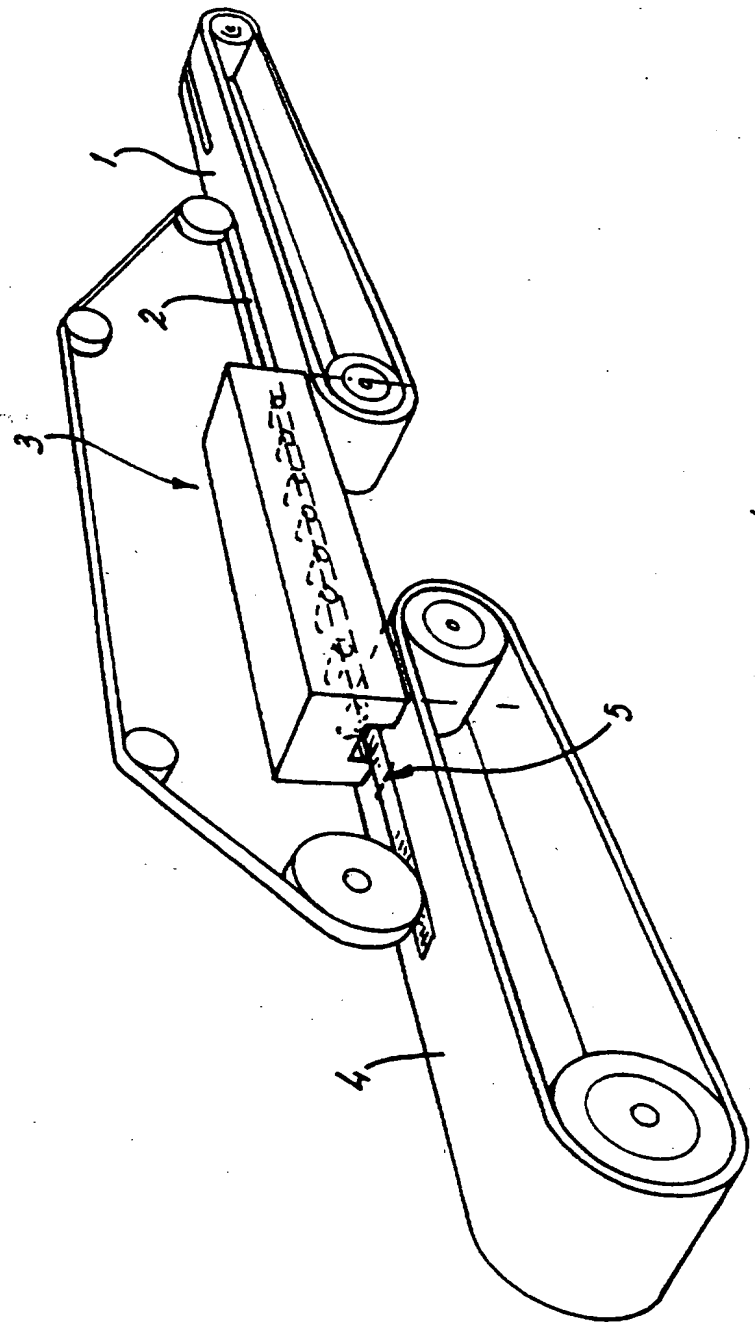

Fig.1

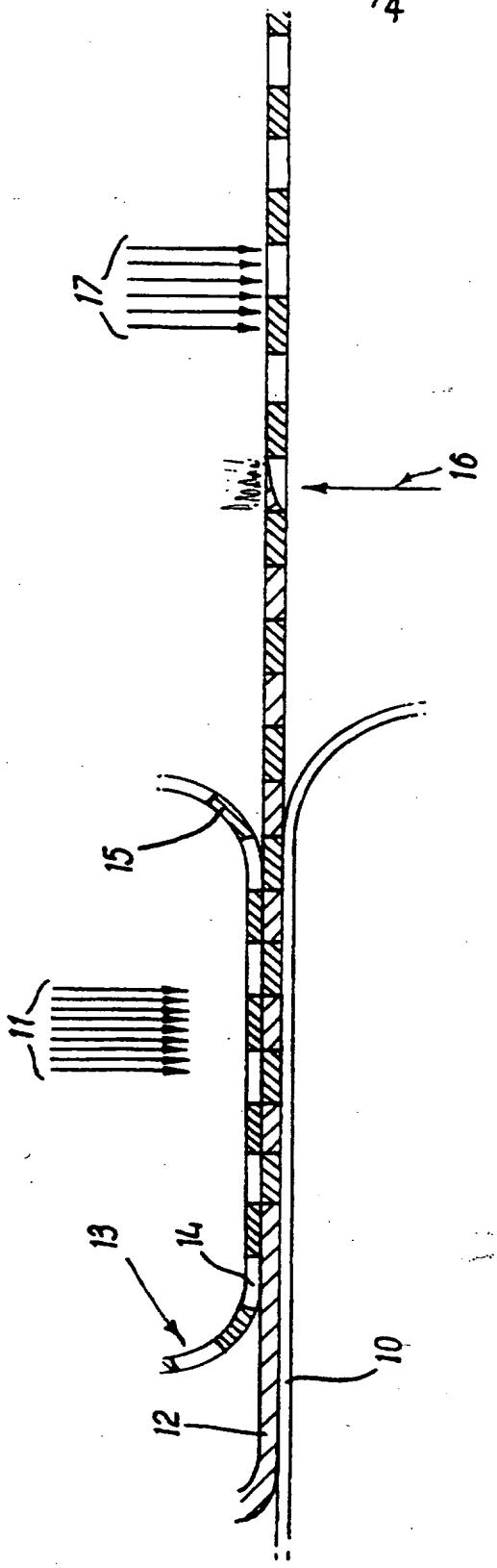

FIG.2

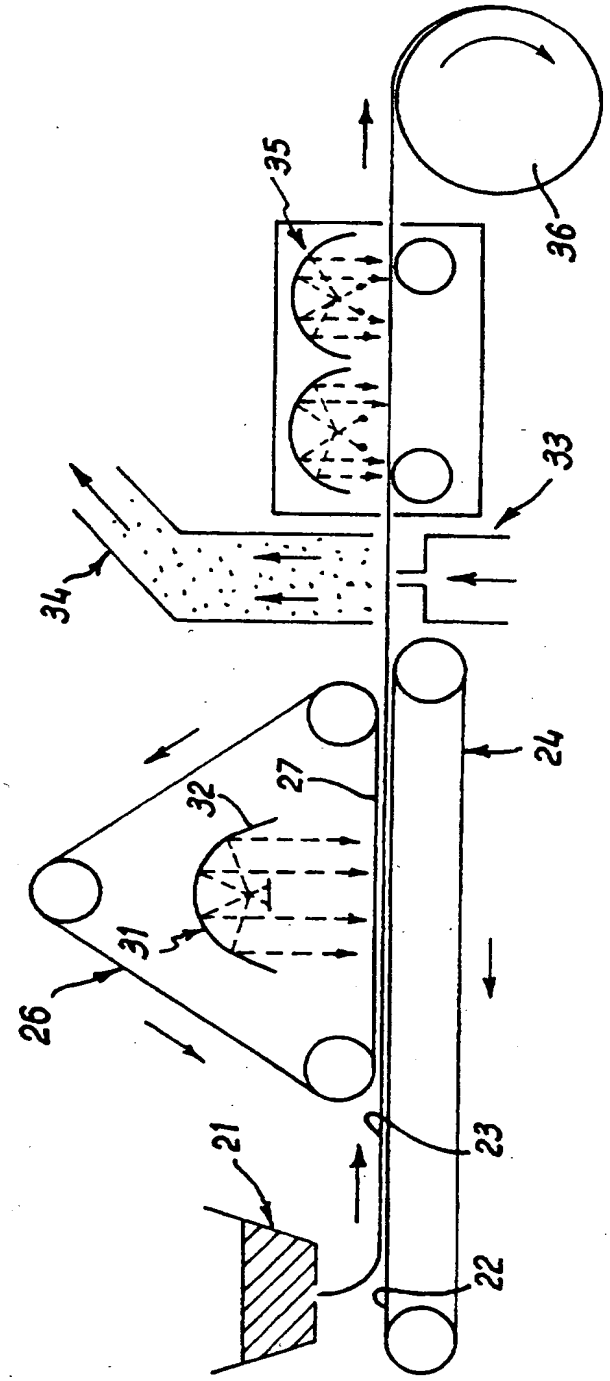

FIG.3

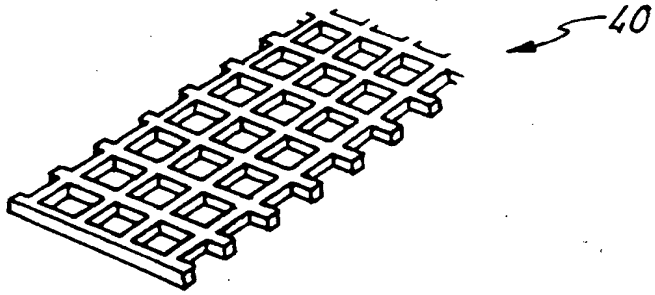

FIG. 4

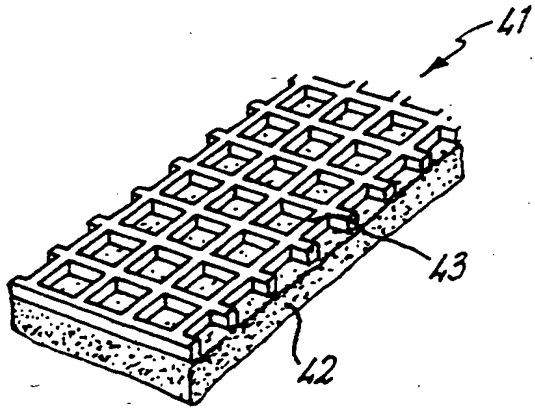

FIG. 5

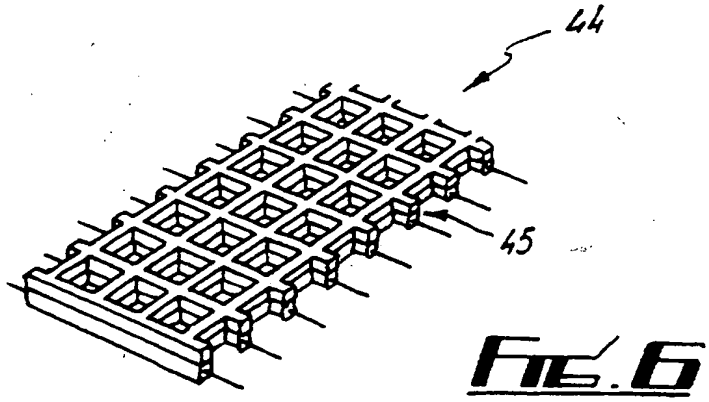

FIG. 6

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PC /GB 97/00454

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A24C5/18 B29C35/10 D21F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A24C B29C D21F B65G B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 241 915 A (SCAPA GROUP PLC) 18 September 1991 see the whole document	1-7,10, 12-14
A	EP 0 370 450 A (MAX SCHLATTERER) 30 May 1990 see the whole document	1,14
A	GB 1 067 111 A (JUTE INDUSTRIES LIMITED) 3 May 1967 see the whole document	1,14
A	US 4 514 345 A (JOHNSON) 30 April 1985 see the whole document	1,14
A	WO 92 17643 A (SCAPA GROUP PLC) 15 October 1992 see the whole document	6

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 June 1997	Liliane v. VELZEN-PERON - 4 -07- 1997
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Information on patent family members

Inte onal Application No
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